(d) temporally averaging said detected speckle-noise patterns at said image detection array during said photo-integration time period thereof, thereby reducing the RMS power of observable speckle-noise patterns at said image detection array.--

--671. The method of claim 670, wherein the temporal phase modulation technique practiced during step (b) comprises:

modulating the temporal phase of the transmitted PLIB along the planar extent thereof according to a temporal phase modulation function (TIMF) so as to modulate the temporal phase along the wavefront of the PLIB and produce said numerous substantially different time-varying speckle-noise patterns at the image detection array during the photo-integration time period thereof.--

--672. The method of claim 670, wherein the temporal phase modulation technique practiced during step (b) is selected from the group consisting of: using an optically-reflective cavity (i.e. etalon device) affixed to external portion of each VLD; using a phase-only LCD temporal intensity modulation panel; and using a fiber optical array.--

--673. The method of claim 670, wherein step (b) comprises using the planar laser illumination beam is temporal phase modulated prior to target object illumination employing photon trapping, delaying and releasing principles within an optically reflective cavity (i.e. etalon) externally affixed to each visible laser diode within the planar laser illumination array.--

--674. The method of claim 670, wherein the planar laser illumination beam (PLIB) is temporal phase modulated using a phase-only type LCD-based phase modulation panel prior to target object illumination.--

--675. The method of claim 670, wherein the planar laser illumination beam (PLIB) is temporal phase modulated using a high-density fiber-optic array prior to target object illumination.--

--676. A planar laser illumination and imaging (PLLIM) based system capable of producing digital images with reduced levels of speckle-pattern noise, said PLIIM based camera system comprising:

a planar laser illumination array (PLIA) including a plurality of laser diodes for producing and projecting a planar laser illumination beam (PLIB) so as to illuminate an object as it is moving past said PLIIM based camera system;

an image formation and detection (IFD) module having a image detection array and imaging forming optics for providing said image detection array with a field of view (FOV),

wherein said PLIB and FOV are arranged in a coplanar relationship along the working range of said PLIIM based camera system so that the PLIB illuminates primarily within said FOV of the IFD module; and

a speckle-pattern noise reduction subsystem, integrated with said PLIA, for reducing the temporal-coherence of said planar laser illumination beam (PLIB) before said PLIB illuminates a target object;

said speckle-pattern noise reduction subsystem applying a temporal intensity modulation technique during the transmission of said PLIB towards the target, so that the object is illuminated with a temporally coherent-reduced planar laser illumination beam (PLIB) and numerous substantially different time-varying speckle-noise patterns are produced at said image detection array over the photo-integration time period thereof;

whereby said numerous substantially different time-varying speckle-noise patterns are detected at said image detection array over said photo-integration time period, and said detected speckle-noise patterns are temporally averaged at said image detection array during said photo-integration time period thereof,

thereby reducing the RMS power of observable speckle-noise patterns at said image detection array.--

--677. The PLIIM based camera system of claim 676, wherein the temporal intensity modulation technique comprises modulating the temporal intensity of the transmitted PLIB along the planar extent thereof according to a temporal intensity modulation function (TPMF) so as to modulate the temporal intensity along the wavefront of the PLIB and produce said numerous substantially different time-varying speckle-noise patterns at the image detection array during the photo-integration time period thereof. --

--678. The PLIIM based camera system of claim 676, wherein said speckle-pattern noise reduction subsystem is selected from the group consisting of: an optically-reflective cavity (i.e. etalon device) affixed to external portion of each VLD; a phase-only LCD temporal intensity modulation panel disposed in the optical path of the PLIB being transmitted to the target object; and a fiber optical array disposed in the optical path of the laser beam used to generated said PLIB prior to its transmission to the target object.--

--679. The PLIIM based camera system of claim 676, wherein said speckle-pattern noise reduction subsystem comprises means for photon trapping, delaying and releasing principles within an optically reflective cavity (i.e. etalon) externally affixed to each visible laser diode within said planar laser illumination array.--

--680. The PLIIM based camera system of claim 676, wherein said speckle-pattern noise reduction subsystem comprises a phase-only type LCD-based phase modulation panel disposed in the optical path of said PLIB prior to target object illumination.--

--681. The PLIIM based camera system of claim 676, wherein said speckle-pattern noise reduction subsystem comprises a high-density fiber-optic array disposed in the optical path of said PLIB prior to target object illumination.--

REQUIREMENT UNDER 37 C.F.R. 1.121

As required under 37 C.F.R. 1.121, a clean version of the first paragraph of Page 1 is as follows:

This is a Continuation of copending Application No. 09/990,585 filed November 21, 2001 which is a Continuation-in-Part of: copending Application Serial No. 09/999,687 filed October 31, 2001; copending Application Serial No. 09/954,477 filed September 17, 2001; copending Application Serial No. 09/883,130 filed June 15, 2001, which is a Continuation-in-Part of Application Serial No. 09/781,665 filed February 12, 2001; copending Application Serial No. 09/780,027 filed February 9, 2001; copending Application Serial No. 09/721,885 filed November 24, 2000; Application Serial No. 09/327,756 filed June 7, 1999; and International Application Serial No. PCT/US00/15624 filed June 7, 2000, published as WIPO WO 00/75856 A1; each said application being commonly owned by Assignee, Metrologic Instruments, Inc., of Blackwood, New Jersey, and incorporated herein by reference as if fully set forth herein in its entirety.

Also required under 37 C.F.R. 1.121, a clean set of the amended Claims is provided herebelow:

670. A method of reducing speckle-pattern noise at the image detection array of a planar laser illumination and imaging (PLLIM) based camera system, said method comprising the steps of:

(a) producing a planar laser illumination laser beam (PLIB) within a planar laser illumination and imaging (PLIIM) based system including an image detection array having image forming optics with a field of view (FOV) arranged in a coplanar relationship with said PLIB;

(b) reducing the temporal-coherence of said planar laser illumination beam (PLIB) before said PLIB illuminates a target object, by applying a temporal phase modulation technique during the transmission of said PLIB towards the target, so that the object is illuminated with a temporally coherent-reduced planar laser illumination beam (PLIB) and numerous substantially different time-varying speckle-noise patterns are produced at said image detection array over the photo-integration time period thereof;

(c) detecting said numerous substantially different time-varying speckle-noise patterns over said photo-integration time period; and

(d) temporally averaging said detected speckle-noise patterns at said image detection array during said photo-integration time period thereof, thereby reducing the RMS power of observable speckle-noise patterns at said image detection array.

671. The method of claim 670, wherein the temporal phase modulation technique practiced during step (b) comprises:

modulating the temporal phase of the transmitted PLIB along the planar extent thereof according to a temporal phase modulation function (TIMF) so as to modulate the temporal phase along the wavefront of the PLIB and produce said numerous substantially different time-varying speckle-noise patterns at the image detection array during the photo-integration time period thereof.

672. The method of claim 670, wherein the temporal phase modulation technique practiced during step (b) is selected from the group consisting of: using an optically-reflective cavity (i.e. etalon device) affixed to external portion of each VLD; using a phase-only LCD temporal intensity modulation panel; and using a fiber optical array.

673. The method of claim 670, wherein step (b) comprises using the planar laser illumination beam is temporal phase modulated prior to target object illumination employing photon trapping, delaying and releasing principles within an optically reflective cavity (i.e. etalon) externally affixed to each visible laser diode within the planar laser illumination array.

674. The method of claim 670, wherein the planar laser illumination beam (PLIB) is temporal phase modulated using a phase-only type LCD-based phase modulation panel prior to target object illumination.

675. The method of claim 670, wherein the planar laser illumination beam (PLIB) is temporal phase modulated using a high-density fiber-optic array prior to target object illumination.

676. A planar laser illumination and imaging (PLLIM) based system capable of producing digital images with reduced levels of speckle-pattern noise, said PLIIM based camera system comprising:

a planar laser illumination array (PLIA) including a plurality of laser diodes for producing and projecting a planar laser illumination beam (PLIB) so as to illuminate an object as it is moving past said PLIIM based camera system;

an image formation and detection (IFD) module having a image detection array and imaging forming optics for providing said image detection array with a field of view (FOV),

wherein said PLIB and FOV are arranged in a coplanar relationship along the working range of said PLIIM based camera system so that the PLIB illuminates primarily within said FOV of the IFD module; and

a speckle-pattern noise reduction subsystem, integrated with said PLIA, for reducing the temporal-coherence of said planar laser illumination beam (PLIB) before said PLIB illuminates a target object;

said speckle-pattern noise reduction subsystem applying a temporal intensity modulation technique during the transmission of said PLIB towards the target, so that the object is illuminated with a temporally coherent-reduced planar laser illumination beam (PLIB) and numerous substantially different time-varying speckle-noise patterns are produced at said image detection array over the photo-integration time period thereof;

whereby said numerous substantially different time-varying speckle-noise patterns are detected at said image detection array over said photo-integration time period, and said detected speckle-noise patterns are temporally averaged at said image detection array during said photo-integration time period thereof,

thereby reducing the RMS power of observable speckle-noise patterns at said image detection array.

677. The PLIIM based camera system of claim 676, wherein the temporal intensity modulation technique comprises modulating the temporal intensity of the transmitted PLIB along the planar extent thereof according to a temporal intensity modulation function (TPMF) so as to modulate the temporal intensity along the wavefront of the PLIB and produce said numerous substantially-different time-varying speckle-noise patterns at the image detection array during the photo-integration time period thereof.

678. The PLIIM based camera system of claim 676, wherein said speckle-pattern noise reduction subsystem is selected from the group consisting of: an optically-reflective cavity (i.e. etalon device) affixed to external portion of each VLD; a phase-only LCD temporal intensity modulation panel disposed in the optical path of the PLIB being transmitted to the target object; and a fiber optical array disposed in the optical path of the laser beam used to generated said PLIB prior to its transmission to the target object.

679. The PLIIM based camera system of claim 676, wherein said speckle-pattern noise reduction subsystem comprises means for photon trapping, delaying and releasing principles within an optically reflective cavity (i.e. etalon) externally affixed to each visible laser diode within said planar laser illumination array.

680. The PLIIM based camera system of claim 676, wherein said speckle-pattern noise reduction subsystem comprises a phase-only type LCD-based phase modulation panel disposed in the optical path of said PLIB prior to target object illumination.

681. The PLIIM based camera system of claim 676, wherein said speckle-pattern noise reduction subsystem comprises a high-density fiber-optic array disposed in the optical path of said PLIB prior to target object illumination.